MOSER STEFAN PROCESS OPTIMIZATION

Course description

„Design of Experiments Basics", & "Quality by Design-DoE"

In practice, the "COST principle" or "Change One Setting at a Time" is still frequently used for the development, run-in, trouble shooting and optimization of technical processes and products.

This is usually associated with several disadvantages and leads to suboptimal planning of the project schedule, budget, and resources. A scientific and reliable evaluation of process performance requires a well-structured approach and high data quality. "Quality by Design - Design of Experiments" is the most effective approach to achieve these goals. Cause and effect of processes are analysed and visualized in comparatively few experiments. Parameters and factors are weighted in their influence and the obtained results are evaluated. In addition, the influence of "uncontrollable" parameters can be recorded in relation to the process result.

Current software packages such as "Modde pro" support a guided, structured evaluation and interpretation of customer-specific test plans. If, in principle, a technical solution is possible, software-based target search is an elegant way to highlight these areas using cause-effect models. Furthermore, this approach helps to identify the target areas with holistic, safe and wide tolerance bands, even for several target variables.

COURSE OBJECTIVE: Enabling participants

- Introduction to qualified problem formulation.
- Creating efficient experimental plans according to the individual problem.
- Analysing experimental data with validated statistical methods.
- Improvement and optimization of products and processes.
- Robustness testing, qualification, and validation of processes/products.
- Interpretation of existing and supplementary test results to generate knowledge.
- Better estimation of process limits or product risks.
- Creation of reports including descriptive diagrams and graphs.

Who should attend?

The course is intended for technicians, laboratory staff, scientists, engineers from all areas of industry and science. Typical applications are product development, process optimization, validation, and quality control. Prior knowledge of statistics is not required. The flexible course allows all participants to be picked up.

COURSE CONTENT

- - Understanding of the QBD-DOE concept including problem formulation.
- - Data modelling and diagnosis.
- - Creation of a solid basis for further decisions
- - Interpretation and derivation of optimal process settings and limits
- - Qualitative evaluation of process robustness
- - Introduction to "Design Space Validation" or Robust Set-Point according to the "QBD" concept
- - Practical application - linking to the needs and focus of the participants

Note

Experience has shown that courses with more than 12 participants suffer from a didactic point of view. For larger groups (>=14), I recommend splitting the course or bringing in a supporting second trainer.

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Proven course concepts for orientation / discussion

"Where" and "How" Design of Experiments is applied

Day 1

Basis-Training

- Placing the DoE method in the context of "Design for Six Sigma" and "Quality by Design".
- Pointing out the limitations of the DoE approach.
- Factor definition, correct factor and correct range (variation).
- Introduction to problem formulation, methods and tools
- Definition of objectives, factors, desirable functions, model types and designs.
- Construction and analysis of full and partial factorial experimental designs
- Analysis and interpretation of raw data / integration of existing data
- Regression analysis, interpretation of models
- Exercises followed by discussion

Focus on Screening, Characterization and Optimization

Day 2

Basis-Training

- Screening designs, what factors dominate the process and what are their optimal setting ranges / working ranges?
- Presentation of efficient designs to reduce the amount of the experiments.
- What to do after screening, optimization, or how to change/adjust follow-up complementary experimental designs?
- Check if effects/models are linear, complex, or just complicated?
- RSM experimental designs for optimization, how to find optimal regions using automated methods such as the simplex algorithm.
- Presentation of potential optima and trade-offs.
- Evaluation of results, assessment of process capability.
- Introduction to design space validation using the QBD approach.
- Exercises followed by discussion (*own examples are welcome*).
- Reflection / lessons learned / summary

Focus on optimization, robustness, and process capability

Day 3

Advanced-Training

- Deepening of "Design Space Validation" with "robust" working point.
- Introduction to the concept of process capability based on process probabilities.
- Presentation of software-based automated algorithms for calculating the safest and widest possible tolerance bands in multi-dimensional test space using Monte Carlo simulation.
- As well as the calculation of hypercube tolerances to maximize safety using the "Manhattan distance" algorithms.
- Comparison of possible working points in terms of yield and robustness.
- Presentation of approaches for robustness testing and process validation.
- Exercises followed by discussion (own examples are welcome).
- - Reflection / lessons learned summary using a visual DoE recipe (FlowChart) https://stefanmoser.com/files/Cooking_recipe_V05.pdf

Special cases and special test arrangements

Master-klassen

E.g. mixture designs, hierarchical modelling, investigation of graphs or spectra as target, complementary designs, preparation of existing measurement data, stability checks, Red-Mup designs, special customer-tailored courses, reflection preparation of customer DoE's.

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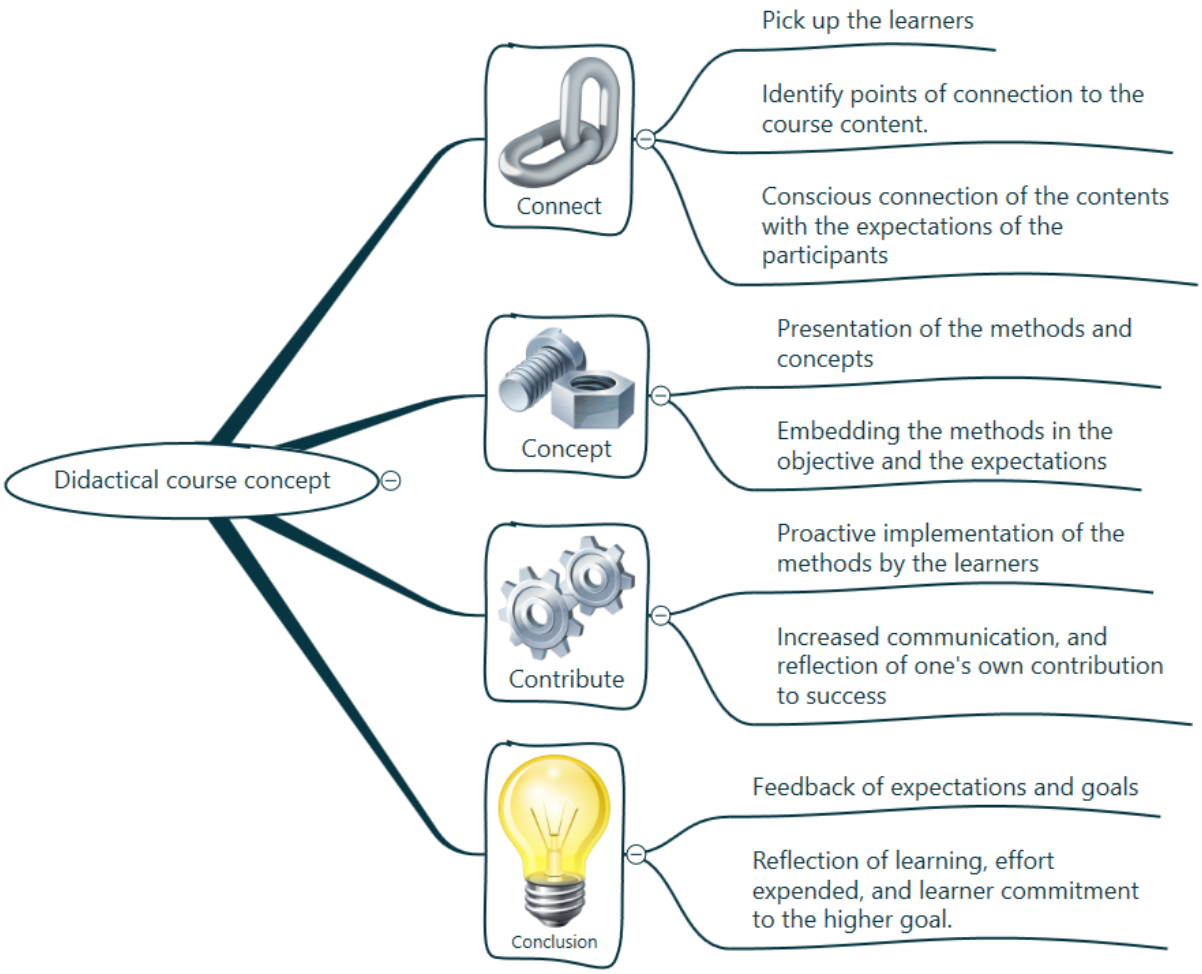
Concept and structure of my trainings and workshops



Optional project support, coaching, mentoring, moderation, facilitation:

- Coaching/support in the start-up phase (online/offline),
- Accompanying coaching / mentoring / training on the job.
- Coordination of DoE activities and processes as well as analyses
- Support in the problem formulation phase: e.g. DFSS, DMAIC, DMADV workshops with
  - SIPOC, Ishikawa, morphological box (Zwicky Box), Pugh Matrix, Shainin toolbox
  - Multivariate analysis of existing data to build a DoE's
  - Contradiction matrix, methods for prior., QFD, decision trees
  - Determination of measurement capabilities according to V1,V2,V3
  - Correlation of attributive, subjective results with possible numerical evaluations.
  - Suggestions e.g. https://stefan-moser.com/files/ProjektManagement.pdf

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Requirement for the training and training room

- ✓ Lecture language: German on request English
- ✓ Documentation: English

- ✓ Beamer
- ✓ Flipchart
- ✓ Whiteboard
- ✓ Min. one computer per two participants
- ✓ Power supply (multiple sockets)

- ✓ Newer standard PC or laptop
- ✓ Resolution min. 1024x768
- ✓ Windows 10 is required;
- ✓ Windows on Mac do need special Licenses please let me know in advance

- ✓ Temporary licenses of the software are provided by the trainer free of charge
- ✓ Software Modde pro V.13+ or current Fa. Umetrics / Sartorius

- ✓ Catering is provided by the client

In addition to the extensive practical "hands-on" tasks to consolidate and deepen the theoretical knowledge, practical exercises **can** also be integrated into the course. These **can** be provided by the customer or, for example, run through with my wooden catapults.
This gives the course a **much longer knowledge half-life.** It is fun and brings even more **positive momentum** to the training.

Please keep in mind that this requires a little more course time +2-3h. On the other hand, students still remember the "other" lecture with the catapults years after the training ... *And that is saying something!*

Questions, suggestions … and to set up your individual training! I am at your disposal.

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